

continuing to develop the new technologies and improve existing technologies. It is likely that these new inventions will enhance their competitiveness in the United States and global markets.

Patenting Outside the United States

In most parts of the world, foreign inventors account for a much larger share of total patent activity than is the case in the United States. When foreign patent activity in the United States is compared with that in 11 other important countries in 1985, 1990, and again in 1996, only Russia and Japan had less foreign patent activity. (See figure 7-23 and appendix table 7-13.)

What is often obscured by the rising numbers in foreign-origin patents in the United States is the success and widespread activity of U.S. inventors in patenting their inventions around the world. In 1996, U.S. inventors led all other foreign inventors not just in countries neighboring the United States, but also in distant and diverse markets, such as Japan, France, Italy, Brazil, India, Malaysia, and Thailand. (See figure 7-24.) Japanese inventors edge out Americans in Germany and dominate foreign patenting in South Korea. German inventors lead all foreign inventors in Russia; they are also quite active in many of the other countries examined.

Venture Capital and High-Technology Enterprise

One of the most serious challenges to new entrepreneurs in the innovation process is capital—or the lack thereof. Venture capitalists typically make investments in small, young companies that may not have access to public or credit-oriented institutional funding. Venture capital investments can be long term and high risk, and may include hands-on involvement by the venture capitalist in the firm. Venture capital thus can aid the growth of promising small companies and facilitate the introduction of new products and technologies, and is an important source of funds used in the formation and expansion of small high-technology companies. This section examines investments made by U.S. venture capital firms, by stage of financing and by technology area.

The pool of capital managed by venture capital firms grew dramatically during the 1980s as venture capital emerged as a truly important source of financing for small innovative firms. (See text table 7-7.) By 1989, the capital managed by venture capital firms totaled \$33.5 billion, up from an estimated \$4.1 billion in 1980. The number of venture capital firms also grew during the 1980s—from around 448 in 1983 to 670 in 1989.

In the early 1990s, the venture capital industry experienced

Text table 7-5.

Top 15 most emphasized U.S. patent classes for corporations from the United States, Japan, and Germany: 1997

United States	Japan	Germany
1. Surgical Instruments	Photography	Printing
2. Biology of multicellular organisms	Information storage and retrieval	Plant protecting and regulating compositions
3. Surgery: light, thermal, and electrical applications	Electrophotography	Clutches and power-stop control
4. Surgery: application, storage, and collection	Liquid crystal cells	X-ray or gamma ray devices
5. Prosthesis	Facsimile	Organic compounds (includes classes 532–570)
6. Computers and digital processing	Typewriting machines	Fabrication of plastics and earthenware
7. Data processing	Television signal processing	Machine element or mechanism
8. Special receptacle or package	Printing of symbolic information	Winding, tensioning, or guiding devices
9. Telephone communications	Optics: systems and element	Metal deforming
10. Communications: Directive radio wave systems	Active solid-state devices	Internal combustion engines
11. Chemistry: Molecular biology and microbiology	Radiation imagery chemistry	Coating or plastic fabrication
12. Chemistry: Natural resins or derivatives	Storage or retrieval of magnetic information	Paper making
13. Information processing system organization	Internal-combustion engines	Power-driven conveyors
14. Cryptography	Television	Sheet feeding or delivering
15. Chemistry: analytical and immunological testing	Electrical generator or motors	Synthetic resins or natural rubbers

NOTE: Ranking is based on patenting activity of nongovernment U.S. or foreign organizations, which are predominantly corporations. Patenting by individuals and governments is excluded.

SOURCE: U.S. Patent and Trademark Office, Office of Information Systems, TAF Program.

Text table 7-6.

Top 15 most emphasized U.S. patent classes for corporations from South Korea and Taiwan: 1997

South Korea	Taiwan
1. Television signal processing for recording	Semiconductor device manufacturing process
2. Television	Etching substrate processes
3. Static information storage and retrieval	Solid state devices
4. Semiconductor manufacturing process	Metal treatment
5. Electric lamp and discharge devices	Coded data generation or conversion
6. Dynamic information storage or retrieval	Electrical nonlinear devices
7. Dynamic magnetic information storage or retrieval	Illumination
8. Coded data generation or conversion	Electrical connectors
9. Electric heating	Supports
10. Refrigeration	Fluid sprinkling, spraying, and diffusing
11. Electric lamp and discharge devices	Receptacles
12. Miscellaneous active electrical nonlinear devices	Audio processing systems and devices
13. Liquid crystal cells, elements and systems	Computer graphics processing
14. Winding, tensioning, or guiding	Static information storage and retrieval
15. Electrical power supply or regulation systems	Electronic digital logic circuitry

NOTE: Ranking is based on patenting activity of nongovernmental organizations, which are primarily corporations. Patenting by individuals and governments is excluded.

SOURCE: U.S. Patent and Trademark Office, Office of Information Systems, TAF Program.

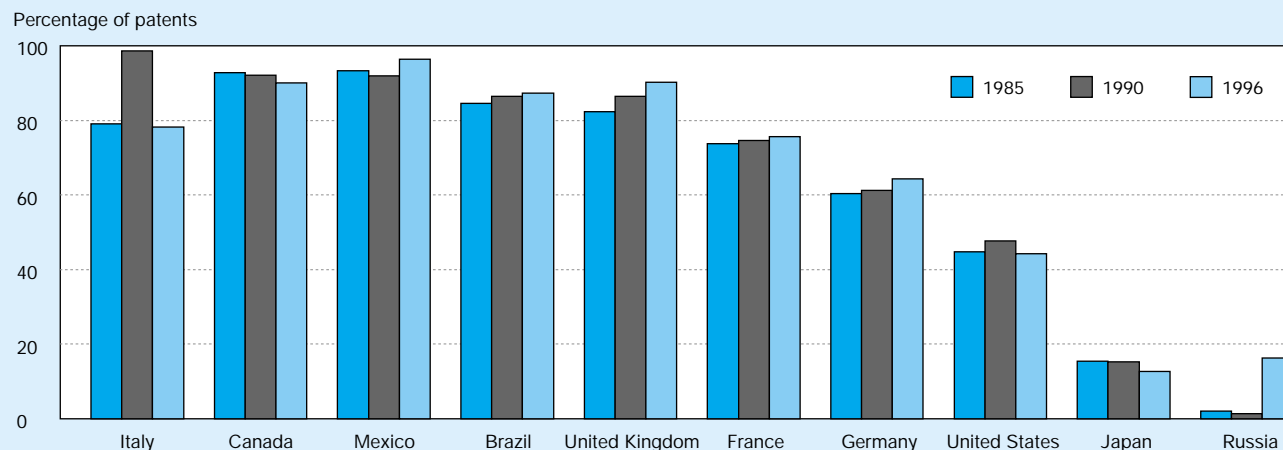
Science & Engineering Indicators – 2000

a recession of sorts, as investor interest waned and the amount of venture capital disbursed to companies declined—especially compared to the extensive venture capital activity of the late 1980s. The number of firms managing venture capital also declined during the early 1990s, but the slowdown was short-lived. Investor interest picked up during 1992, and disbursements began to rise. Both investor interest and venture capital disbursements have continued to grow through 1998. The latest data show that total venture capital under management rose to \$84.2 billion in 1998, more than double the amount managed just three years earlier.

California, New York, and Massachusetts together account for about 65 percent of venture capital resources. It appears that venture capital firms tend to cluster around locales considered to be “hotbeds” of technological activity, as well as in states where large amounts of R&D are performed.²³

²³Discussion on the location of venture capital firms is derived from data presented in Venture Economics Information Services (1999). Data on U.S. R&D performance by state are presented in chapter 4, “Higher Education in Science and Engineering.”

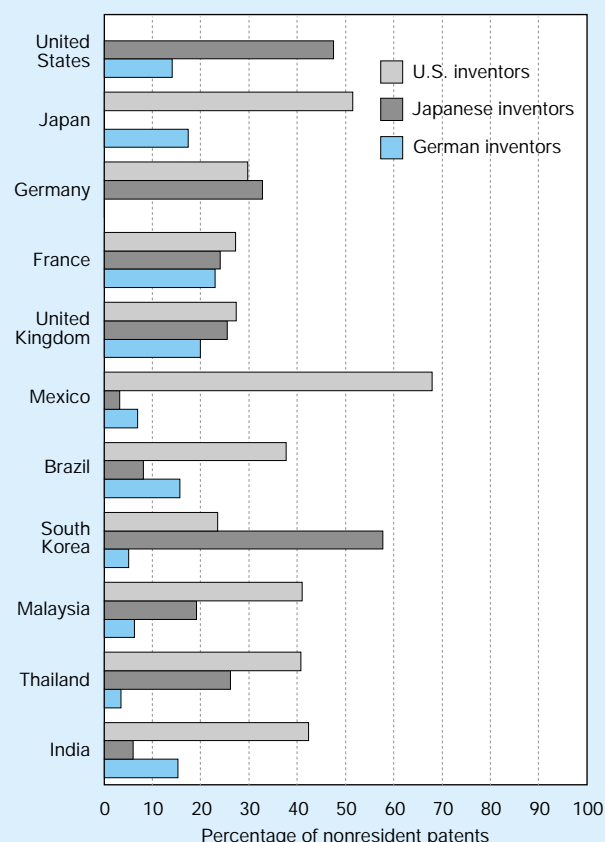
Figure 7-23.
Share of total patents awarded to nonresident inventors



See appendix tables 7-12 and 7-13.

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Figure 7-24.
Patents granted to nonresident inventors: 1996



NOTE: Data for Malaysia and Thailand taken directly from source documents.

See appendix table 7-13. *Science & Engineering Indicators – 2000*

Venture Capital Commitments and Disbursements

Several years of very high returns on venture capital investments have stimulated increased investor interest. This interest soared from 1995 to 1998, with new commitments reaching \$25.3 billion in 1998, up from \$15.2 billion in 1997, and \$10.5 billion in 1996. Pension funds remain the single largest supplier of new funds, supplying nearly 60 percent of committed capital in 1998. Corporations are the next largest source, supplying 12 percent of committed capital, followed closely by individuals at 11 percent.²⁴

Starting in 1994, new capital raised exceeded capital disbursed by the venture capital industry. In each of the following years, that gap has grown larger and larger, creating surplus funds available for investments in new or expanding innovative firms. Since 1990, firms producing computer software or providing computer-related services generally received the largest share of new disbursements. (See figure 7-25 and appendix table 7-14.) In 1990, software companies received 17

Text table 7-7.
Venture capital under management in the United States: 1980–98
(Millions of U.S. dollars)

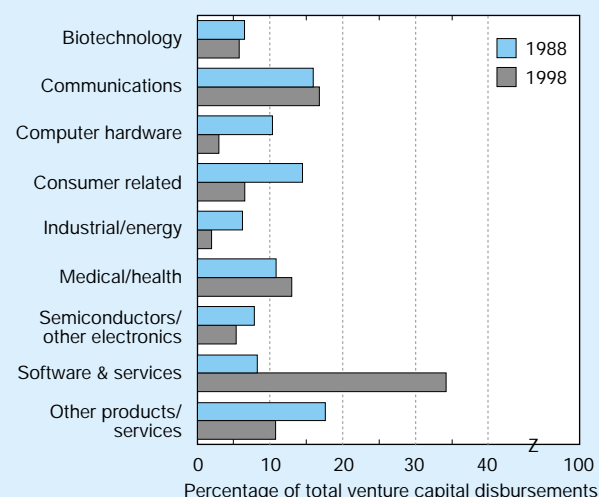
	New capital committed	Total venture capital under management
1980	2,073.6	4,071.1
1981	1,133.2	5,685.7
1982	1,546.4	7,758.7
1983	4,120.4	12,201.2
1984	3,048.5	15,759.3
1985	3,040.0	19,330.6
1986	3,613.1	23,371.4
1987	4,023.9	26,998.5
1988	3,491.9	29,539.2
1989	5,197.6	33,466.9
1990	2,550.4	34,000.9
1991	1,488.0	31,587.2
1992	3,392.8	30,557.3
1993	4,115.3	31,894.0
1994	7,339.4	34,841.3
1995	8,426.7	38,465.0
1996	10,467.2	46,207.2
1997	15,175.6	59,614.5
1998	25,292.6	84,180.1

SOURCE: 1999 National Venture Capital Association Yearbook, Venture Economics Information Services (1999).

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percent of all new venture capital disbursements, twice the share going to computer hardware companies and biotechnology companies. That share rose to 27 percent in 1993, and again in 1997. The latest data show software companies receiving more than one-third of all venture capital disbursements in 1998. Telecommunications companies also attracted

Figure 7-25.
U.S. venture capital disbursements,
by industry category: 1988 and 1998



See appendix table 7-14. *Science & Engineering Indicators – 2000*

²⁴Based on information contained in Venture Economics Information Services (1999).

large amounts of venture capital during the 1990s, and edged out software companies for the lead in 1992 and 1994. Medical and health-care related companies received a large share of venture capital throughout the 1990s, reaching a high of 18 percent in 1994 before dropping to 14 percent in 1998. Computer hardware companies, an industry highly favored by the venture capitalists during the 1980s, received just 3 percent of total venture capital disbursements in the most recent period.

Venture Capital Investments by Stage of Financing

The investments made by venture capital firms may be categorized by the stage at which the financing is provided:²⁴

- ◆ *Seed financing*—usually involves a small amount of capital provided to an inventor or entrepreneur to prove a concept. It may support product development, but rarely is used for marketing.
- ◆ *Startup financing*—provides funds to companies for use in product development and initial marketing. This type of financing usually is provided to companies that are just getting organized or to those that have been in business just a short time, but have not yet sold their products in the marketplace. Generally, such firms have already assembled key management, prepared a business plan, and made market studies.
- ◆ *First-stage financing*—provides funds to companies that have exhausted their initial capital and that need funds to initiate commercial manufacturing and sales.
- ◆ *Expansion financing*—includes working capital for the initial expansion of a company, funds for either major growth expansion (involving plant expansion, marketing, or development of an improved product development), and financing for a company expecting to go public within six months to a year.
- ◆ *Acquisition financing*—provides funds to finance the purchase of another company.²⁵
- ◆ *Management and leveraged buyout*—includes funds to enable operating management to acquire a product line or business from either a public or private company. Often these companies are closely held or family owned.²⁶

For this report, the first three are referred to as early-stage financing and the remaining three as later-stage financing.

An examination of venture capital disbursements by financing stage clearly shows that most of the funds are di-

rected to later-stage investments. Since 1982, later-stage investments captured between 59 and 75 percent of venture capital disbursements, with the high and low points both reached in the 1990s. In 1998, later-stage investments represented 72 percent of total disbursements. (See figure 7-26 and appendix table 7-15.) Capital for company expansions attracted by far the most investor interest with this financing stage alone attracting more than half of all venture capital disbursed since 1995.

Contrary to how venture capital is often viewed, only a relatively small amount of venture capital goes to the struggling inventor or entrepreneur trying to prove a concept or to help with product development. Over the 19-year period examined, such seed money never accounted for more than 6 percent of all venture capital disbursements, and most often represented between 2 and 4 percent of the annual totals. Seed financing represented about 5 percent of all venture capital in four of the last five years. Consistent with observations made when all venture capital investments are examined, firms developing computer software, telecommunications technologies, and those classified as medical and health-related are the largest recipients of venture capital seed-type financing in the late 1990s. (See appendix table 7-16.) Computer software is the leading technology area receiving seed-type financing, although its share is slightly lower than that seen in the examination of total venture capital investments (34 percent overall versus 32 percent as seed money). Recently, telecommunications firms gained favor with forward-looking venture capitalists and attracted 21 percent of venture capital seed-stage investments in 1998, up from 15 percent in 1997, and 7 percent in 1996. Medical and health-related firms received about 20 percent in each of the last two years examined.

Figure 7-26.
U.S. venture capital disbursements, by stage of financing: 1987-98

